Introduction to information seeking behavior—A review of literature and field practice directions

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Abstract The article tries to discover the major authors in the field of information seeking behavior via social network analysis. It is to be accomplished through a literature review and also by focusing on a graphic map showing the seven most productive co-authors in this field. Based on these seven authors' work, five probable research directions about information seeking behavior are discerned and presented.

1 Introduction

As important reference resources of library services, library information systems, library workflows, library websites, and the study of information seeking behavior are some of the main research areas in library science.

In the physical library building, when a person uses a library or communicates with library staff, a series of encountering phenomena takes place such as follows:

> access→contacting with the media→technology and computer→ information→borrowing items→returning items→independent learning→ pay fine, suggestion box system and the layout of the library→librarians' professional expertise→catalog, index, classify, rules and regulations[1–3].

However, the role of the Internet has become increasingly important for both educators and students to obtain useful information. The model of readers' information seeking behavior considers not only their behavior in the library building but also the general information environment in their living and work surroundings. It takes into account the rapid development of the information environment, in which learners live in an interactive communication village of common knowledge sharing and common knowledge creation. These unprecedented new challenges

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bring in a new model to understand readers' information seeking behavior and also to effect a structural change in terms of library workflows, website design and the whole library automation system.

Therefore, the need to discuss information seeking behavior in the information age depends on combining the elements of the currently established different models. The major goal of this author's current project is to discern and explore new research directions in information seeking behavior field. The approach is by way of conducting both a social network analysis toward a co-author relationship in the field of information seeking and a research on those key authors' considerations for online information seeking behavior. This paper presents one part of this project by using Ucinet (free social network analysis software) to calculate the journal articles in LISA (library and information science database).

2　Research design, assumptions and major issues

The research design uses a social network analysis by drawing up a map of co-authors' relationships. As those key authors are having major positions in the social network, their works suggest the probable directions of information seeking behavior in the information age. Some assumptions in this current project are as follows:

- The journal articles included in LISA represent the most relevant works and research papers in the subject field of information seeking behavior;
- The map of co-author relationships represents the scholarly community and its mutual relationship in the said subject field;
- The key positions within this social network represent those held by the most prominent authors; and
- The works of the key authors represent the most important knowledge about online information seeking behavior.

In order to project the probable research directions about information seeking behavior in the future, the first step is to find the key authors in the field of information seeking behavior by analyzing the researchers' common social network relationships. The second step is to exmaine their published works and find out their contributions on this topic.

Pursuant to the stated goals of the project and the research design, this author expantiate information seeking behavior by addressing the following three pertinent core issues:

- What does the social network relationships of those authors look like?
- Who are the major players within the social network?
- Which directions of research on the information seeking behavior?

Both Question 1 and Question 2 are addressed in the "Result" of social network analysis in this paper, but Question 3 is presented in the "Discussion" such on this paper. The conclusion of this paper includes the summary of practice directions, study limitations and future research.

3 Research method and process

The research method is a social network analysis: A kind of data mining approaches. There are four steps: data collection, data clearance, data analysis, and graphic interpretation.

1st step.   Data collection is to retrieve articles from LISA, and the process is to input "information seeking" as the keywords for search. There were 1,889 items downloaded from that database on September 1, 2008.

2nd step.   Data clearance is to write a computer program (using the JAVA platform) in order to transfer data format. The format ".txt" used in LISA database was transformed into another form of format ".txt" which can be processed by the Ucient.

3rd step.   Data analysis is to use Ucinet to calculate each author's number of publications, their cooperative number, and the co-authors' relationship.

4th step.   Graphic interpretation is to present the map which includes some network nodes (authors) and network lines (cooperative relationship). By simplifying the map of social network relationship, the final graph shows more directly and clearly the key author's location and relationship number.

Using these 4 steps of the above mentioned research process, the research result shows in two graphs: One is the whole map of the co-authors' relationship, the other is the simplified map of the key authors' strength (the number of published articles) and influence (the social relationship network).

4 Result

Based on the above process, a graph is drawn below for the purpose of elucidation. There are two maps of the social network relationship in the research field of information seeking behavior.

The first map is shown in Fig. 1. It answers the first research question about what the social network relationships of those authors look like. It shows that there are three main groups (in the middle of the graph) and many other occasional authors (on the left list of the picture). For a better understanding of the key authors, their work team and their social relationship network, Fig. 2 is developed for simplification based on Fig. 1.

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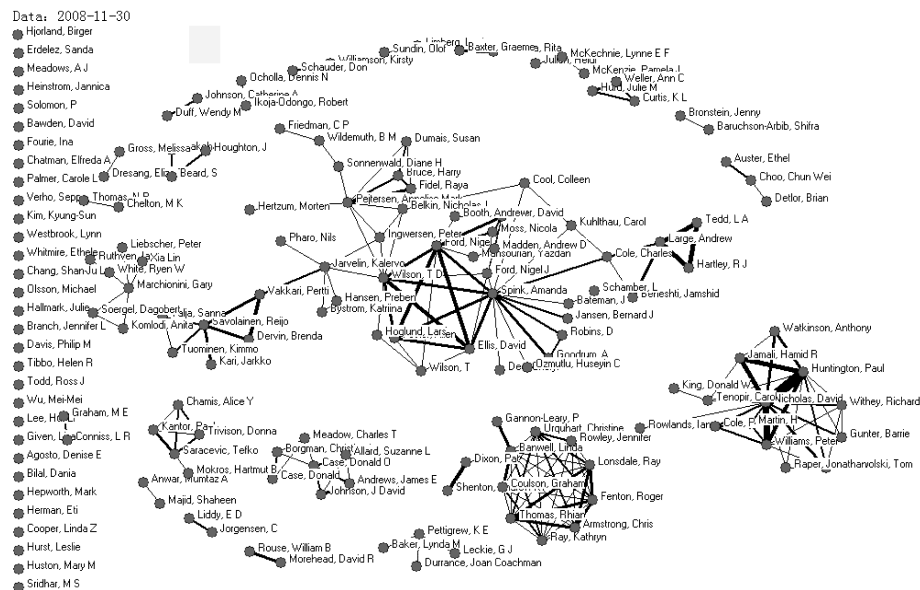Sciences

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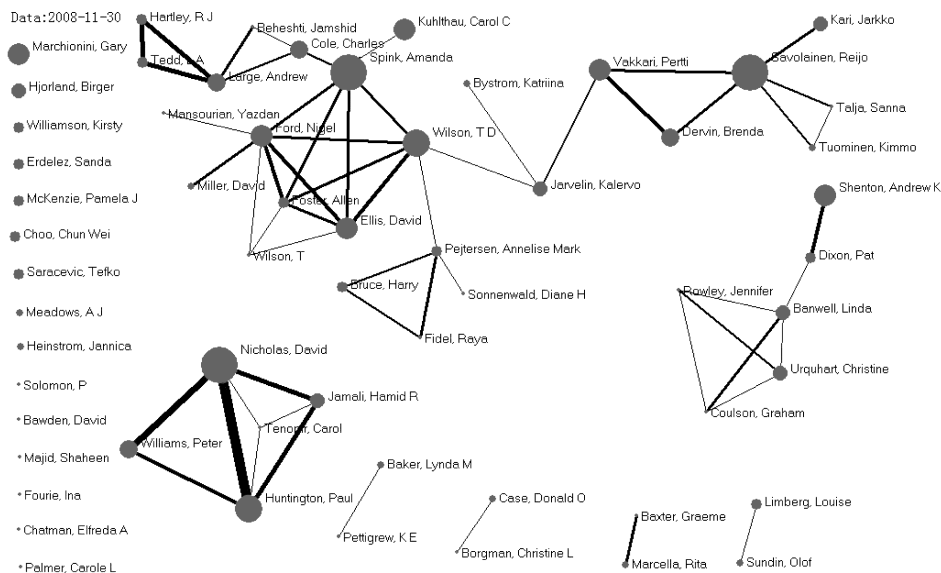Fig. 1   Map of collaboration of information seeking researchers.

Fig. 2   Map of key authors' social relationship network.

Fig. 2 answers the second research question about who are the major players within the social network? In Fig. 2, the map shows their power and influence.

5   Discussion

Based on analysis of Fig. 1 and Fig. 2, seven key authors were selected to represent the current main stream in the field of online information seeking behavior. They are: 1) Amanda Spink who is studying information systems and log analysis; 2) Reijo Savolainen who takes everyday life theory in sociology as the basis for research; 3) David Nicolas whose area of research is Log analysis and E-Scholar, even though he has devised his own model; 4) T. D. Wilson who is well-known for the study of information behavior model in the field of information seeking; 5) David Ellis whose study of other authors' models is the main undertaking; 6) Corl C. Kuhlthau who is famous for the Information Search Process Model; 7) Gary Marchionini whose research focuses is on information seeking in the electronic environment.

The first and foremost researcher and team of online information seeking behavior field are led by Amanda Spink. As a prolific scholar, Spink's work includes many aspects, such as human information behavior (information seeking and use of information)[4], information needs and information retrieval systems[5], evaluation of medical information systems[6–7], the theoretic framework of information science based on information seeking behavior[8], cognitive styles in information seeking[9], sexual information seeking on Web search engines[10], multimedia collections on Web searching[11] (based on search engine, cognitive psychology and human behavior), multitasking Web search[12–14], measurement of user behavior in retrieval system or search engines[15–17], Web search[18–20], Web log analysis[21–22], the mobile data access system[23], and user's selected behaviors.[24–27]

Spink collaborates widely with other experts in the field. Taking the view of information retrieval system (IRS), she cooperates with different experts to complete research in search engines, users' behavior, Web searching, medical information and cognitive psychology. After collaboration with Kuhlthau C. C since 1991[28],whose study in the past 20 years has taken the same model and has further deepened her research step by step through empirical research, Spink changed her research directions so as to keep pace with the progress of the information environment focusing on new issues and factors.

The second most prominent author and his led research team in this field are Reijo Savolainen. He takes the everyday life approach of sociology as the basis for researching information seeking behavior[29–33]. In addition, Savolainen has established the model of information retrieval which includes a Web user-generated

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model[34], a social cognitive model[35], spatial factors of information seeking[36], academic capital and information seeking career (librarian's professional ability)[37] and time as a context for information seeking[38]. The latest Schematic Model of Information Seeking Process[38] takes time as the main target. It indicates: 1) Time is the basic variable for scenes or framework of information seeking; 2) time is a necessary condition for access to information; 3) time is the measurement standard of the information seeking process.

The third leading author and his led team are David Nicolas. From the beginning of 1987 (when the number of information seeking articles increased) to 2005, Nicolas' study discovered the education applications[39] and systemic observation of user's behavior[40]. The latest articles related to log analysis[41–43] as well as to the scholars in the virtual environment[44–45]. Nicolas collaborated several articles with Williams P and Huntington P. in the field of E-Scholar.

The fourth author and his led team are T. D. Wilson. After cooperative work on cognitive-oriented information behavior, Wilson continued the study of information seeking for many years[46]. Compared to Peter Ingwersen, whose work is on cognitive research of information seeking[47], his study is more about different ways of information seeking behavior[47–48] and is often used in comparison with Kulthuau's model[49–50]. The fundamental difference between Wilson and Kuhlthau is that Wilson considers the issues from the perspective of user's information needs, retrieval and usage (reading) whereas Kuhlthau considers the issues from the viewpoint of the relationship between the user's behavior and their mentality during information seeking process. In other words, Users/readers' feelings were the focused concerns of Prof. Kuhlthau, whereas the efficiency was primary concern of Prof. Wilson. Wilson combines those research works from West Germany and Britain[51], whereas Kuhlthau puts forward her model coming from five empirical investigations in universities[52]. Wilson communicated with Reijo Savolainen on information use and information retrieval[53] in 1997. In 2000–2002, he participated in an investigative project with David Ellis[54]. Wilson's research includes user learning[55], user studies[56] and uncertainty[57] in order to resolve the practical problems of users[58–59].

The fifth author and his led team are David Ellis. Ellis made the model of information seeking in a wide range of subjects, such as comparison between physical and social sciences[60], medical practice[61], industrial environment[62], academic researchers[63], and so on. Other scholars have created a model for research purposes; However, the purpose of Ellis' research is about how to use these models. Ellis' collaborative work increased after 2000. Rather than building a small research team like that of David Nicolas, Ellis collaborated with those more prolific scholars[64–66], such as Wilson T. D, Ford N., Foster A., and Spink A., to show more active academic communication.

The sixth author and her led team are C. C. Kuhlthau. Kuhlthau has proposed the famous six steps of information searching: task initiation, topic selection, refocus exploration, focus formulation, information gathering and search closure. Her study also included two concepts: namely, uncertainty and intervention. Since the model is very clear and flexible, a number of theories and/or investigations were established based on her work. For example, by using the model of Kuhlthau, Burdick[67] found that females could get emphatic points more easily than male during the process of focus formulation. However, it is not clear that there is any difference between males and females in terms of getting the end result of the information retrieval process. In Doris's doctoral dissertation[68], the author contends that graduate students show more anxiety in the first and third steps of Kuhlthau's model when they are searching for information. Jones[54] directly used Kuhlthau's model as a template to design an in-depth interview to study the behavior of nurses searching for medical information on the Web. In Esmaeel's[69] doctoral dissertation, the author used Kuhlthau's model to design his empirical research framework and found that 41% of respondents consider that they are always in the "information gathering" step, which is the fifth step in the process. Kyunghye Kim created a model of information seeking that included Kuhlthsu's model[70]. In addition, Susan[71], Naseer[72], Abdulmohsin[73] all quoted Kuhlthau's model in their research.

The seventh author and his led team are Gary Marchionini. Marchionini's Process Model of Information Seeking[74] describes the process from contact problem to solving the problem in 8 detailed steps: 1) Recognize and accept an information problem; 2) define and understand the problem; 3) choose a search system; 4) formulate a query; 5) execute search; 6) examine search results; 7) extract information; 8) reflect, iterate and stop. The information seeking process is systematic. Currently, Marchionini still maintains an active team. Their research has deviated from the information seeking behavior to the exploration of the intelligence of search engines.

To compare the above seven authors and their research groups, Table 1 shows the directions and main contributions of them.

Table 1   Main models and their applications

Authors and their group	Main model	Application aspects
Amanda Spink	Web search	Log analysis
Reijo Savolainen	Information seeking process	Information society
David Nicolas	User behavior	End user's behavior
T.D. Wilson	Information needs	Information retrieval system
David Ellis	Information behavior	Application and comparing
Corl C. Kulthau	Information search	User education
Gary Marchionini	Process of Information seeking	Search engine

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In combining the contributions of the seven authors and the elements of their models, the five probable research directions are discerned as follows:

- A virtual community changes the process of information seeking behavior in the information age day by day. Relevant to the research on library or department of information consultation in the past, there are great difficulties and differences in defining user groups. That means the identification of a single user and its purpose of information retrieval should be changed to an identification of many users and their collective characteristics and behaviors.

- In the web-based information environment, it has a close approximity of the two actions of execution and evaluation that Norman proposed when he described the HCI (human-computer interaction) in 1986[75]. That is because the information resource is not a single source in Web; user can choose other resources more than ever before, which will lead to the interactions between execution and evaluation. The process of information retrieval may be composed of numerous short processes.

- Although the information retrieval process may not be a sophisticated system formula, it is a series of simple steps of repetitious retrieval exercises. The dynamic communication between users and computers is not just one way. The information communication is a kind of interaction between many users and many computers. Information seeking behavior includes not only the user's psychological and social factors but also other factors such as: the personal learning process, the influence of culture and language, information technology changes, organization culture and atmosphere, information access skills, critical thinking, imaginative ability, ambition and creativity and so on. Therefore, the traditional library service has to face these new challenges and impacts resulting from the applications of new information technologies.

- Although the task-oriented information seeking behavior still exists, it has more non-commissioned activities and informal information retrieval functions. Such phenomena includes not only users' information needs, information retrieval skills and their purpose of information use but also users' unique personal approaches for information seeking such as surfing, browsing, searching and book-marking, etc. Information retrieval has developed from a one-way and closed style to a two-way and open-ended style. The discussion about the information needs of individuals may be extended to the needs of groups. A user's information retrieval approach will influence his or her information needs and information usage at the same time.

- In the future, a non-linear and dynamic model of information retrieval, from the starting point to an end at any step in between, cannot be simply ignored

or excluded from any research undertakings. With the increase of the scope and extent of the adoption of information technologies, the influence of social and organizational factors becomes increasingly more important. The minute as a timeframe is to become the most important unit of measurement in the Web-based information service environment. Any model of information retrieval should factor the time variable into consideration.

6 Conclusion

In the information age, it is absolutely necessary for a researcher, who in conducting on the information seeking needs, to take into account more elements than ever before. The opportunity of interactive communication for both the educator and the student is now much greater. How people communicate with each other and what kind of social software will be helpful in information seeking are currently a topic of high profile in library and information science.

Summing up the seven key authors' contributions is a practical and useful way to find out the valuable elements of current models of information seeking behavior. It is hoped that this work will be helpful in developing more research possibilities in order to understand what the information seeking behavior in the future might be possibly evolving toward. The impact of information technologies does not mean that previous models should be ignored but rather it reminds researchers to optimize models based on some of those previously established models. It is also the reason why we have discussed in more detail about the five discerned general directions in this paper.

However, the major works that we presented here do not necessarily cover all the relevant contributions to the research in this field. We collected the data only from LISA. Moreover, we selected a few key authors and their works by means of using only one kind of data mining skill. Besides, to retrieve articles by using only the words "information seeking" may run into the risk of not being able to retrieve all the most important and/or relevant articles regarding to information seeking. These are some of the research limitations of this paper and it means that we have to study this topic more in-depth in the future.

Even though there are some limitations, we believe that any new research designs in this subject area can be reasonably formulated by taking into consideration of the above stipulated five general directions and of the distinctive elements from some of those relative works which we have carefully selected.

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